

Spin correlations on a frustrated honeycomb

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We present a detailed analysis of the Heisenberg and Kitaev–Heisenberg models on a single hexagon. For frustrated Heisenberg interactions with nearest neighbor (J_1) and next-nearest neighbor (J_2) antiferromagnetic couplings various types of order have been suggested which compete with disordered states: (i) valence-bond crystal [1], or (ii) plaquette resonating valence-bond state [2]. We derive the energy spectra using an exact diagonalisation of a single hexagon as well as spin–spin correlation functions for different parameter regimes. For the Heisenberg J_1 - J_2 Hamiltonian we recover the lowest part of the energy spectrum for a single hexagon presented in [2]. We also investigate the evolution of the energy spectra and spin correlations between Ising and Kitaev, Ising and Heisenberg, as well as between Heisenberg and Kitaev model for a spin liquid. Finally, we consider a single hexagon within a cluster mean-field approximation introduced in [1] and demonstrate the tendency towards symmetry breaking away from the Kitaev limit.

References:

- [1] A. F. Albuquerque *et al.*, Phys. Rev. B **84**, 024406 (2011).
- [2] R. Ganesh, S. Nishimoto, and J. van den Brink, Phys. Rev. B **87**, 054413 (2012).